TITLE: **HEAT OF DISSOLUTION MEASUREMENTS FOR CO_2 IN MIXED ALKANOLAMINE SOLVENTS**

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1. ABSTRACT

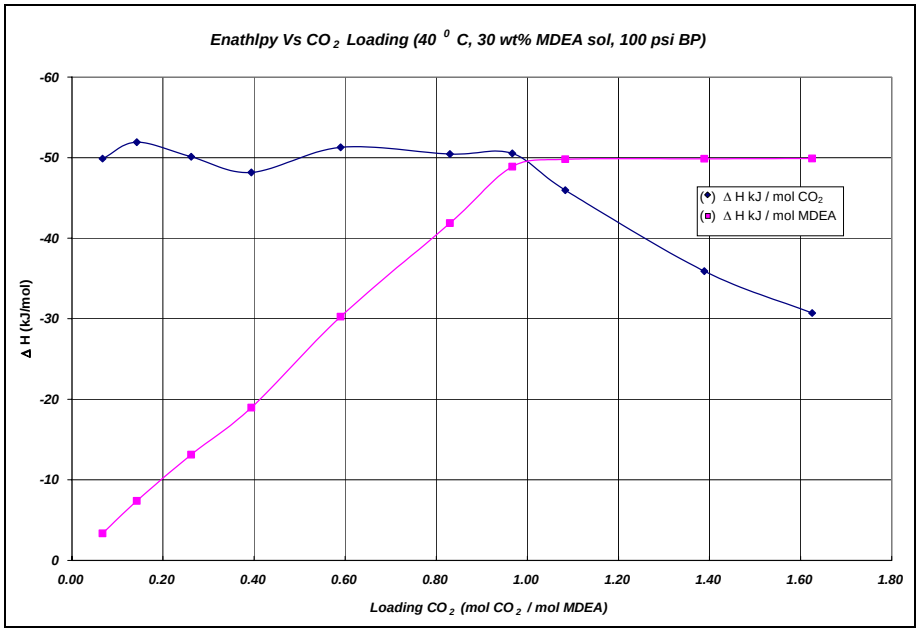
Objectives

The main objective of this project is to measure heat of dissolution of CO_2 in carefully selected mixed alkanolamine solvent systems, and provide such directly measured data that might be used for efficient design of CO_2 capture processes, or for better understanding of thermodynamics of CO_2- alkanolamine systems. For more economical CO_2 capture and regeneration, there is a need for development of more efficient solvent systems. In this project we will extend the thermodynamic database by measuring heat of solution data of CO_2 in mixed solvents made of MEA (monoethanolamine), MDEA (methyldiethanolamine), piperazine, and water. Mixed solvents of different compositions will be selected and in each case data will be measured over a temperature range and various partial pressures of CO_2. At the end of the project, observations, conclusions, and recommendations will be derived for the choice of mixed solvents for efficient CO_2 capture with potential for commercialization.

Accomplishments To Date

During the past year of the project, the data measurements for solubility and enthalpy of solution of carbon dioxide in aqueous MEA and MDEA solutions have been completed. For MEA-CO_2 system, data were measured at 15^{o}C, 40^{o}C and 70^{o}C, and for aqueous solutions containing 15, 30 and 50 wt% MEA. For MDEA-CO_2 system, data were measured at 15^{o}C, 40^{o}C and 75^{o}C, and for aqueous solutions containing 20, 30 and 50 wt% MDEA. All measurements were carried out at a total pressure of 100 psia. In a

typical measurement, at a fixed flow rate of liquid solution, CO_2 rate was steadily increased. This resulted in an increase in the rate of heat generated, until the aqueous solution was saturated with CO_2, at which point the heat generation rate leveled off. This is shown in the diagram below for the MDEA-CO_2 data point for 30 wt% MDEA solution at 40^{o}C and 100 psi. For this case the solubility of CO_2 was measured as 0.975 moles of CO_2 per mole of MDEA, and the heat of solution was -49.26 kJ/mol of CO_2.



Simultaneously, the electrolyte-NRTL model available in the literature (Austgen et al., Ind. Eng. Chem. Res. 28, 1060-1073, 1989) has been evaluated with the literature solubility data compiled for aqueous CO_2-MEA, CO_2-MDEA, CO_2-DEA, CO_2-MDEA-MEA, and CO_2-MDEA-DEA systems. Ways to extend the model for simultaneous computation of solubility of CO_2, and heat of solution of CO_2 in these aqueous alkanolamine systems are currently being investigated.

Future Work

The work planned during the next phase of this project is outlined below.

- Data measurements for aqueous CO_2 –MEA-MDEA-PZ multi-component systems will be completed
- The electrolyte-NRTL model will be extended for simultaneous computation of solubility and heat of solution of CO_2 in these aqueous alkanolamines.
- Optimum compositions of alkanolamines in aqueous solutions will be recommended for CO_2 removal from gas mixtures.

2. LIST OF PUBLICATIONS AND SUPPORTED STUDENTS

Publications: None yet, an article and a presentation are in preparation.

Students Supported Under the Grant

- Sureshkumar Gutti, Ph.D. student in chemical engineering, NC A&T State University